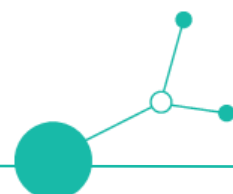


RE/UPskilling Program LP1

D 2.1.1

ME - Maker engineering





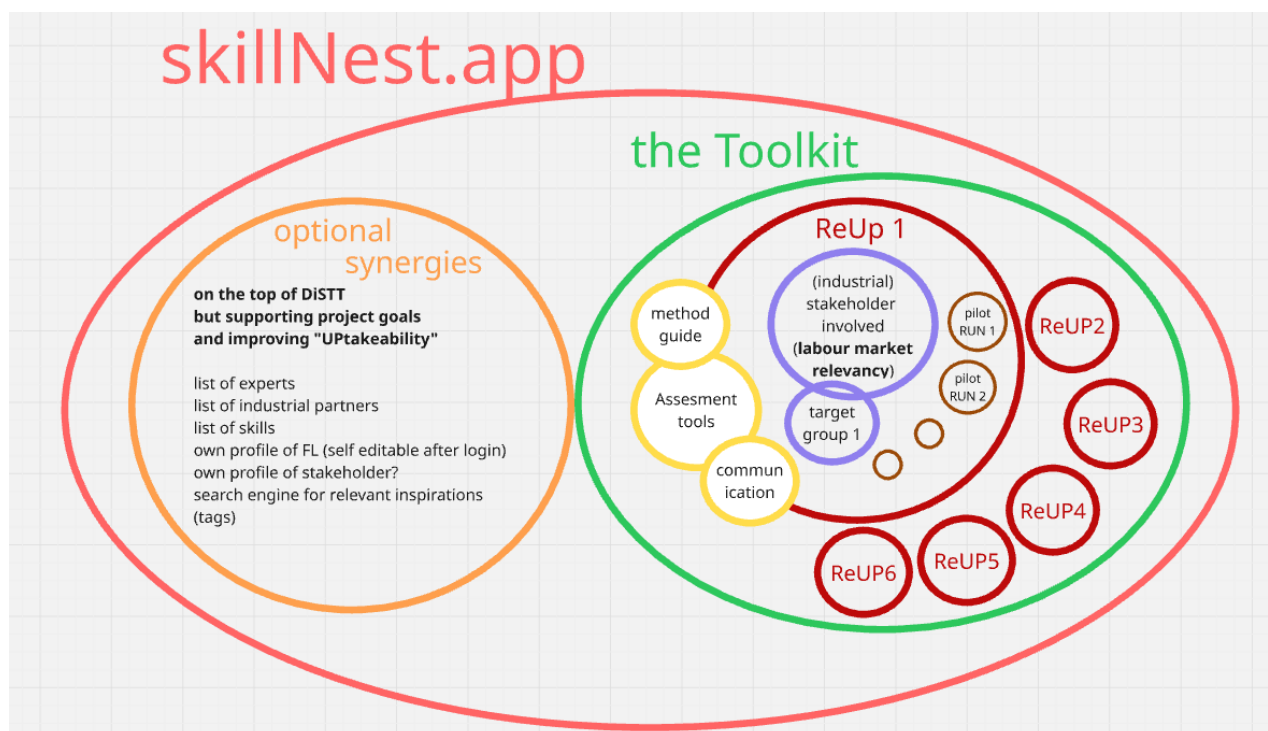
General introduction

Re/UpSkilling programs are a part of Digital Skills Transformation Toolkit DiSTT. The “Toolkit” is defined by project proposal as a comprehensive solution to address the skills gaps and support the digital fabrication skills transformation process to foster labour market workforce. It consists of re/upskilling programs, designed by each DiSTT partner to meet the needs of target groups and to fill identified skillGaps in the regions.

The target is to enable educators (typically Fab Labs and Makerspaces) to offer structured, high-quality training inspiration and resources, which leads to the fostering innovation, bridging the gap between education and industry, and preparing individuals for the challenges of an evolving technological world.

This educational program is designed by LP1, strojLAB team from Brno University of Technology. The aim of the strojLAB team is to maximize impact of the FabLab facilities within the university to deliver principles such as labour market relevancy by closer involving industrial stakeholders into the educational process, showing them benefits to work closely with university students and to deliver to the university students real world examples of trends that will be beneficial for them after they fully enter labour market after their graduation.

Implementation of the Toolkit into the SkillNest.app



SkillNest.app as a platform for uptake Toolkit by others

SkillNest.app is web based platform designed to deliver DiSTT outputs to the wider audience. Currently it consists of Pilot RUN browser and skill expert list. Later it will provide whole RE/UP programs and other features to be discussed also with “uptakers” and stakeholders. The primary reason for it is to offer inspiration for other educators and to provide useful content for wider positive impact to the labour markets beyond DiSTT project



The Toolkit defined by Strategy document

To ensure consistency across outputs of the DiSTT project we provide summary of the key decisions valid for designing Re/Up programs - the core of the project

Conclusion for the Toolkit (sum-up)

The DiSTT Toolkit will be WEB based HUB, portal or application which will not be just a set of learning materials, but a **comprehensive framework for digital skills transformation** that:

- bridges hands-on learning with labor market needs,
- supports long-term sustainability of FabLabs as educational hubs,
- ensures transferability, openness, and scalability across Europe.

Key Components of the Toolkit defined in the Strategy document

1. Modular Educational Programs

examples:

- “**Learn-it!**” - technical and theoretical preparation
- “**Make-it!**” - hands-on workshops and project-based learning
- Ready-to-use curricula and learning units for different levels
- Localization options to suit regional contexts

2. Assessment and Feedback Tools

examples:

- Pre- and post-module self-assessment questionnaires
- Continuous formative evaluation by facilitators
- Criteria for evaluating prototypes, projects, and teamwork
- Recommendations for informal certification or skill recognition

3. Implementation & Methodological Guide

examples:

- Guidelines for program deployment in FabLabs
- Role of the facilitator and design of the learning environment
- Tips for cooperation with schools, industry, and local partners
- Best practice examples and sustainable operational models

4. Communication and Outreach Materials

examples:

- Templates for promoting training programs
- Messaging strategies for schools and companies
- Tools for community building and sharing results

5. Open Platform / Repository

examples:

- Online access to all materials (e.g., Moodle, Git, website)
- Possibility to adapt and contribute content
- Open licensing to support widespread adoption



LP1 RE/UPskilling program

title of the RE/UP program:

Maker engineering

Target group LP1:

Target group of people to be trained by RE/UP program is university and complementary high school students (19-26 y/o) lacking up-to date skills

LP1 pedagogical approaches to the Re/Up program

Plan of LP1 to the pedagogical approach remains.

- **Project-Based Learning (PBL)** FME BUT uses Project-Based Learning to cultivate critical thinking and problem-solving by engaging students in collaborative, real-world engineering projects.
- **Interdisciplinary Collaboration** FME BUT promotes cross-disciplinary collaboration through initiatives like strojLAB, where students from various engineering fields work together on diverse projects, mirroring real-world engineering environments.
- **Hands-On Experience and Maker Culture** FME BUT integrates maker culture by providing access to advanced labs and workshops like strojLAB, equipped with tools like 3D printers and CNC machines, enabling hands-on prototyping and practical skill development.
- **Student Autonomy and Reflective Learning** The curriculum is designed to promote autonomy, encouraging students to take initiative in their learning processes. Reflective practices, such as self-assessment and peer feedback, are integral components, allowing students to evaluate their progress and identify areas for improvement.
- **Design Thinking** methodology is actively integrated into education to foster creativity, user-centered problem-solving, and rapid prototyping skills among students. It is particularly emphasized in project-based courses, innovation labs and cooperation with industry partners.

LP1 program main stakeholders

1. Technical Universities to uptake approaches to the education in the STEM fields
2. Educators (individualities, international educators for mobilities)
3. Industrial partners
4. International students (for mobility programs)

LP1 main purpose of the program

- skill-building (UPskilling)
- industry related innovation and collaboration

LP1 clear learning outcomes

- **Applied knowledge** (using gained knowledge practically)



- **Problem oriented thinking** (going straight to the core of the problem, ability to find it, solve it and demonstrate prototyped solution)
- **Proactive attitude in the innovation ecosystem** (working in the teams and interact with external mentors)
- **Learning by failing** (don't worry to fail, rather accept failures in the iteration process)

LP1 target competencies

- **problem solving (design thinking)** (ability to act realistically to the problem and what is needed for the solution, to take in to the account level of the skills of individual, teams,)
- **digital fabrication skills** (to understand what technology can realistically can produce and how to produce/manufacture/fabricate)
- **CAD/CAM** (fabrication aware methodologies of designing parts for digital fabrication)
- **code electronics (microcontrollers)** (ability to electrically "revive" machines eg. with arduino and servo drives)
- inspection of parts

General Skill List (According to the Blueprint)

3D Printing / Additive Manufacturing	Operating 3D printers 3D modeling and slicing software, additive rules Maintenance and troubleshooting of 3D printers
Laser cutting (CNC cutting)	Operating laser cutters Vector graphic design for laser cutting Material selection and settings adjustment
CNC Machining	Operating CNC machines (e.g., routers, mills) CAM software (e.g., Fusion 360, Mastercam, RhinoCAM, SprutCAM) Toolpath generation and machine setup
3D scanning	Operating 3D Scanners Scanning Techniques Post-Processing Scans Integration with CAD Applications of 3D Scanning
2D & 3D design (and computer simulation)	2D and 3D CAD software (e.g., AutoCAD, SolidWorks, Tinkercad) Parametric design, Algorithmic design Technical drawing and blueprint creation



Robotics & Automation	Basic robotics concepts and design Assembling and programming robots Integration of sensors and actuators Understanding of automation systems PLC programming Integration of automation components
Makers soft skills	Effective communication of ideas and concepts Prototype iteration and improvement Documentation and presentation skills Teamwork and collaboration Design thinking



LP1 developed Program Curricula

Curriculum development: Based on the needs confirmation performed in Activity A1.1, create a modular and flexible curriculum for each target group that covers needed digital fabrication skills. The curriculum will follow the structure defined by Activity A1.3 in the project proposal.

List of expected program formats

The Blueprint output has established a consistent format and structure for the re/upskilling programs, outlining key components and requirements.

- **Module outline:** A clear and consistent format for presenting each module within the program, including module title, objectives, duration, topics covered, and learning activities.
- **Graphical template:** A standardized graphical template for all re/upskilling programs, ensuring a cohesive visual identity and design across program materials. The template will include guidelines on the use of colors, fonts, logos, and other design elements, as well as layouts for common components such as slides, handouts, and participant guides.
- **Learning activities:** A uniform approach to describing and categorizing learning activities such as lectures, workshops, hands-on exercises, case studies, or group projects, ensuring consistency in the presentation and organization of these components across programs.
- **Instructor guidelines:** A standardized set of instructions and guidance for instructors and facilitators, detailing their roles and responsibilities, as well as any required qualifications, expertise, or training.
- **Assessment criteria:** A uniform set of criteria for evaluating participant progress and program effectiveness, including the format and structure of assessments, rubrics, and feedback mechanisms.
- **Support materials:** A consistent approach to providing and organizing supplementary resources and materials, such as readings, slides, videos, software, and any other required materials needed for the program, ensuring accessibility and ease of use for both instructors and participants.
- **Language and vocabulary:** Standardized vocabulary and language requirements for all re/upskilling programs, including the provision of both the original language version and an English version to ensure accessibility and understanding for transnational audiences.
- **Quality assurance checklist:** A set of requirements and checkpoints to be met by all re/upskilling programs, ensuring that they adhere to the established format, structure, and quality standards.

Program formats are a standardized template for all re/upskilling programs, including sections for program title, objectives, target audience, prerequisites, duration, and delivery method (e.g., online, in-person, or hybrid), expected outcomes. Following designed formats are relevant for the LP1:



LP1 relevant formats with curricula examples

Project Sprint + Mentoring Format

Structure:

- 1–3-day hackathon/workshop kick-off
- Weekly or bi-weekly consultations with a mentor or industrial partner
- Final presentation or demo day

Pedagogy: Project-based learning, industry-relevant skills

Assessment:

- Pre/post skill questionnaires
- Formative feedback from mentors/partners
- Peer reflection or learning journal

Inspired by: PP2, LP1 Best for: Bridging education and industry, focused team projects

Workshop title	Design Thinking workshop
Target audience	University students
Prerequisites	ability of visual expression and basic verbal communication in english
Purpose & Learning Outcomes	Design thinking methods experienced, Effective communication of ideas and concepts, Prototype iteration and improvement, problem-solving)
Program Format	Context/structure: Project Sprint + Mentoring Format Duration: three intensive days, 4 weekly mentoring follow ups delivery mode: in person, power point output, physical prototyping if applicable
Skill Gaps	Makers soft skills - Design Thinking
Learning Activities	Mixed lectures with discussion and teamwork problem-solving
Assessment	Pre-workshop self-assessment (confidence, familiarity, expectations) - ECTS grading scale Post-workshop self-assessment (learning gains, perceived growth) and End-of-session surveys (content quality, experience, suggestions) - ECTS grading scale Practical outputs (prototype, presentation, pitch)
Roles & Support	Facilitator: BUT educator/lecturer from strojLAB Evaluator: university lecturer (class leader), evaluator from the company (external stakeholder, topic leader)
Feedback	After assessment survey
Showcase or Closure	Final Elevator pitch and gathering realtime feedback from multiple involved authorities from university and company (behalf external stakeholder)
Documents, support materials	Presentation in powerpoint (incl. goals, timeline, rules of the competition)



Language:	Czech, English
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Challenge-Based Learning + Competition

Structure:

- Team formation around real-world challenge
- Ongoing development (either 1-day or multi-week format)
- Final competitive demo day or public showcase

Pedagogy: Game-based and experiential learning

Assessment: Page

- Peer and jury evaluation
- Rubric-based scoring of innovation, feasibility, teamwork
- Optional pre/post self-assessment

Inspired by: LP1 (Pneuracer), PP2, PP3 Best for: Motivation through competition, cross-disciplinary problem solving

Workshop title	Digital manufacturing skills Engineering hackathon
Target audience	high school students
Prerequisites	understanding of technical drawings
Purpose & Learning Outcomes	general: skill-building, innovation, engagement, interdisciplinarity, creativity target competencies: Robotics & Automation (Basic robotics concepts and design), Makers soft skills (Teamwork and collaboration, Effective communication of ideas and concepts, Prototype iteration and improvement, problem-solving)
Program Format	Context/structure: Challenge-Based Learning + Competition Duration: one day delivery mode: in person, hands-on building
Skill Gaps	Makers soft skills - Prototype iteration and improvement Teamwork and collaboration
Learning Activities	short lecture
Assessment	Pre-workshop self-assessment (confidence, familiarity, expectations) - Post-workshop self-assessment (learning gains, perceived growth) and End-of-session surveys (content quality, experience, suggestions) Practical outputs (prototype, presentation, pitch)
Roles & Support	Facilitator: BUT educator/lecturer from strojLAB Evaluator: Self-assessment,
Feedback	Quick survey after each session/module
Showcase or Closure	Final presentation of prototypes in a form of competition



Documents, support materials	Presentation in powerpoint (incl. goals, timeline, rules of the competition) Paper surveys Instructions and guide for instructors (qualifications, responsibilities)
Language:	Czech/English (based on the audience, no baseline requirements needed)

Short term workshop

Structure:

- 1-week structure with a short theme (e.g., “digital prototyping,” “IoT in daily life”)
- Short lecture + lab or FabLab session

Pedagogy: Blended learning, constructivist design

Assessment:

- Ongoing peer feedback
- Instructor formative feedback

Workshop title	Basics of 3D scanning and inspection of machine parts
Target audience	University students
Prerequisites	none
Purpose & Learning Outcomes	Gain experience with 3D scanning systems and inspection, and develop a basic understanding of 3D metrology.
Program Format	1 hour theoretical introduction 6 hours practical workshop
Skill Gaps	3D scanning - overall
Learning Activities	Mixed lectures with practical problem-solving labs and data processing on PCs
Assessment	Pre-workshop self-assessment (confidence, familiarity, expectations) - Post-workshop self-assessment (learning gains, perceived growth) and Practical outputs (digital data)
Roles & Support	Facilitator: BUT educator/lecturer from strojLAB Evaluator: Self-assessment
Feedback	Quick survey after each session/module
Showcase or Closure	Final discussion of the measurement set-up and results
Documents, support materials	Presentation in powerpoint (Introduction lecture + assignment of the problem) Paper surveys Instructions and guide for instructors (qualifications, responsibilities)
Language:	Czech/English (based on the audience, no baseline requirements needed)



Weekly Thematic Studio

Structure:

- 13-week structure with a weekly theme (e.g., “digital prototyping,” “IoT in daily life”)
- Short lectures + lab or FabLab session
- Final open exhibition or pitch

Pedagogy: Blended learning, constructivist design

Assessment:

- Ongoing peer feedback
- Reflective logs / portfolios
- Instructor formative feedback on each milestone

Inspired by: LP1 (weekly teaching), PP3, PP6 Best for: Deep creative exploration, regular peer interaction

Workshop title	Metal powder additive manufacturing skills for engineering applications
Target audience	University students
Prerequisites	Knowledge of any CAD software
Purpose & Learning Outcomes	Knowledge of modern fabrication technologies of metals, understanding of material properties, powder characteristics, and design for additive manufacturing, Practical skills in preparing digital models and prototype optimization, Fabrication process, post-processing and validation methods, Problem-solving.
Program Format	Context/structure: Theoretical lessons supported with practical activities using strojLAB facilities, each participant dealing with his own project task using mentoring and consultations Duration: eleven two-hours exercises distributed into 7 weeks Delivery mode: in person, powerpoint output, physical prototype
Skill Gaps	Operating 3D printers, 3D modeling and slicing software, additive rules Maintenance and troubleshooting of 3D printers
Learning Activities	lectures, laboratories and consultations
Assessment	Pre-workshop self-assessment (confidence, familiarity, expectations) - Post-workshop self-assessment (learning gains, perceived growth) and End-of-session surveys (content quality, experience, suggestions) Practical outputs (prototype, presentation describing prototype design, fabrication and post-process quality)
Roles & Support	Facilitator: BUT educator/lecturer from strojLAB Evaluator: university lecturer (class leader)
Feedback	Quick survey at the end of course
Showcase or Closure	Final presentation of fabricated and post-processed prototypes
Documents, support	Presentation in powerpoint (incl. goals, timeline, knowledge base)



materials	Instructions and guide for laboratory equipment.
Language:	Czech/English (based on the audience, no baseline requirements needed)

LP1 developed Instructional Design tools

As part of the pilot runs, we prepared a variety of teaching materials—most commonly presentations, printed manuals, and assignments—while focusing primarily on a *hands-on* learning approach. At Brno University of Technology (BUT), these materials are made available to students through the university's e-learning platform for each accredited course.

Within the **strojTALK** lecture series, we have increased the involvement of guest lecturers who present specific skills (e.g. large-format 3D printing, Design Thinking) from the perspective of their inspiring professional practice. This approach helps students better recognize the real-world applications of the skills being taught. The recorded talks are also available on the **FME BUT YouTube** channel.

Workshop materials and tools:

- power point presentation with instructions and visualisations (all pilot RUNs)
- video (usually as part of presentations or comparative assessment - strojLAB challenge)
- laptops (for example Pilot RUN: Generative Design in Practice by V. Florián)
- Flipchart templates (for teams during Design Thinking workshops)

LP1 developed Assessment tools

General principles of the Assessment

The core approach is focussed on self-assessment before and after the workshops to estimate the impact of the workshops. Other approaches are individual for each RE/UPskilling program (each DiSTT project partner and their target group). Generally we can distinguish between following:

Assessment of the trainee

- A. self (central pre/after assessment through skillNest) (subjective)
- B. by authority (for LP1 only with hackathons or bigger events) (subjective - credible)
- C. by exact values to be reached (for example correct or incorrect answers in the test)

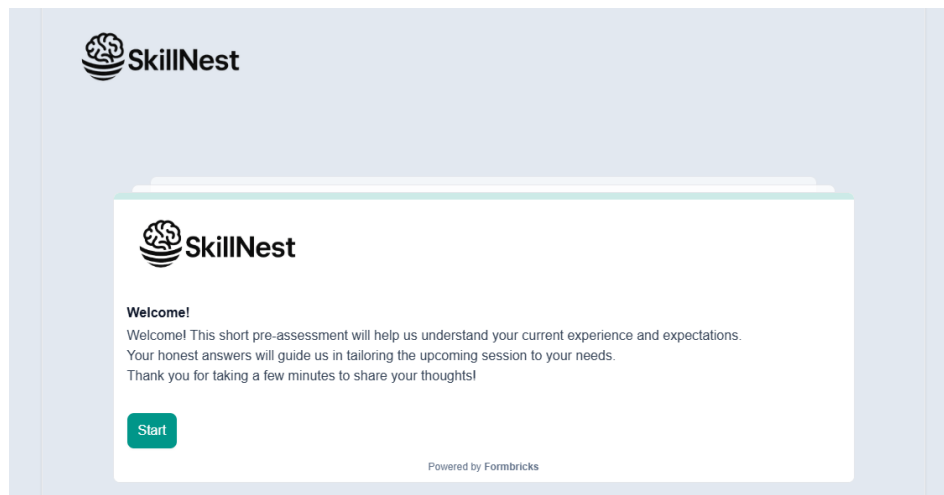
Assessment of the pilot/workshop

- A. by trainee (optional on the skillNest - post-assessment)
- B. by external authority (not planned or to be discussed in person with authorities)



Structure of the skillNest assessment surveys

As general principle for each partner: to provide a common base for the assessment by the participants first 3-6 questions mandatory regarding selected skillGaps to be covered by PilotRUN/workshop. Next questions will be prepared by the lecturer through application. The currently planned app is called FormBrick, which can be implemented into the skillNest and in the range of currently planned purposes in the DiSTT it is for free.



pict: appearance of the pre/after assessment form implemented in the skillNest

LP1 - Assessment Approach defined in the Blueprint

In the DiSTT framework, student assessment combines traditional academic standards with innovative, practice-oriented evaluation methods. While the ECTS grading scale remains in use—particularly within LP1 courses that are formally integrated into accredited study programs—the overall assessment philosophy expands far beyond conventional grading. The focus is on evaluating the quality and functionality of real-world outcomes such as prototypes, design solutions, and projects developed during hackathons, workshops, and collaborative assignments.

This approach emphasizes **formative feedback**, **self-assessment**, and **guided reflection**, enabling students to actively monitor their own progress in digital skills, creative problem-solving, and teamwork. Rather than measuring success solely through grades, DiSTT prioritizes indicators of **creativity**, **initiative**, and **practical competence** that align closely with the expectations of modern industry.

An essential aspect of the DiSTT assessment culture is the personal development of each participant. The process encourages learners to understand and articulate their own perception of the skills they have acquired, fostering self-confidence and a sense of ownership over their learning journey. Whenever possible, direct person-to-person feedback is integrated into the process, often involving **external experts**, **mentors**, or **representatives from industrial partners**, who provide valuable insights from real professional contexts.

By combining formal evaluation with authentic, experience-based feedback, DiSTT ensures that participants not only meet academic requirements but also gain tangible, transferable skills and a realistic understanding of their role within the future workforce.